TEST SPECIFICATIONS AND TASK LISTS FOR THE NATIONAL AUTOMOTIVE STUDENT SKILLS STANDARDS ASSESSMENT

AUTOMOBILE – AUTOMOTIVE SERVICE TECHNOLOGY

The National Automotive Student Skills Standards Assessment (NA3SA) for automotive service technology is comprised of eight examinations covering light vehicle diagnosis and repair. Listed below are the test specifications and task lists for each of these eight exams.

The task lists are simply lists of the tasks involved in the process of diagnosing and repairing problems in the various vehicle systems. The tasks may also be thought of as competencies. Every question found on the NA3SA exams is keyed to one of these tasks. The tasks are organized into content categories, and these content categories, along with the number of questions included in each category, comprise the test specifications. Every form of the exams will be built to meet these specifications.

Students preparing for the NA3SA exams should review the tasks (competencies) listed, and note areas where further preparation may be needed. It also helps students to note how many questions will be included on the exams in each content area.

SUSPENSION AND STEERING

Content Area	Questions In Test
A. General Steering Systems Diagnosis and Repair	11
B. Suspension Systems Diagnosis and Repair	11
C. Wheel Alignment Diagnosis, Adjustment, and Repair	12
D. Wheel and Tire Diagnosis and Repair	6
TOTAL	40

A. General Steering Systems Diagnosis and Repair

1. Disable and enable supplemental restraint system (SRS).

2. Remove and replace steering wheel; center/time supplemental restraint system (SRS) coil (clock spring).

3. Diagnose steering column noises, looseness, and binding concerns (including tilt mechanisms); determine necessary action.

4. Diagnose power steering gear (non-rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action.

5. Diagnose power steering gear (rack and pinion) binding, uneven turning effort, looseness, hard steering, and noise concerns; determine necessary action.

6. Inspect steering shaft universal-joint(s), flexible coupling(s), collapsible column, lock cylinder mechanism, and steering wheel; perform necessary action.

7. Adjust non-rack and pinion worm bearing preload and sector lash.

8. Remove and replace rack and pinion steering gear; inspect mounting bushings and brackets.

9. Inspect and replace rack and pinion steering gear inner tie rod ends (sockets) and bellows boots.

10. Determine proper power steering fluid type; inspect fluid level and condition.

11. Flush, fill, and bleed power steering system.

12. Diagnose power steering fluid leakage; determine necessary action.

13. Remove, inspect, replace, and adjust power steering pump belt.

14. Remove and reinstall power steering pump.

15. Remove and reinstall press fit power steering pump pulley; check pulley and belt alignment.

16. Inspect and replace power steering hoses and fittings.

17. Inspect and replace pitman arm, relay (centerlink/intermediate) rod, idler arm and mountings, and steering linkage damper.

18. Inspect, replace, and adjust tie rod ends (sockets), tie rod sleeves, and clamps.

19. Test and diagnose components of electronically controlled steering systems using a scan tool; determine necessary action.

20. Inspect and test electric power assist steering.

21. Identify hybrid vehicle power steering system electrical circuits, service and safety precautions.

B. Suspension Systems Diagnosis and Repair

1. Diagnose short and long arm suspension system noises, body sway, and uneven ride height concerns; determine necessary action.

2. Diagnose strut suspension system noises, body sway, and uneven ride height concerns; determine necessary action.

3. Remove, inspect, and install upper and lower control arms, bushings, shafts, and rebound bumpers.

4. Remove, inspect and install strut rods and bushings.

5. Remove, inspect, and install upper and/or lower ball joints.

6. Remove, inspect, and install steering knuckle assemblies.

7. Remove, inspect, and install short and long arm suspension system coil springs and spring insulators.

8. Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts.

9. Remove, inspect, and install stabilizer bar bushings, brackets, and links.

10. Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount.

11. Remove, inspect, and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings, and mounts.

12. Inspect, remove, and replace shock absorbers.

13 Remove, inspect, and service or replace front and rear wheel bearings.

14. Test and diagnose components of electronically controlled suspension systems using a scan tool; determine necessary action.

15. Diagnose, inspect, adjust, repair or replace components of electronically controlled steering systems (including sensors, switches, and actuators); initialize system as required.

16. Describe the function of the idle speed compensation switch.

17. Lubricate suspension and steering systems.

C. Wheel Alignment Diagnosis, Adjustment, and Repair

1. Diagnose vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, and steering return concerns; determine necessary action.

2. Perform prealignment inspection and measure vehicle ride height; perform necessary action.

3. Prepare vehicle for wheel alignment on the alignment machine; perform four wheel alignment by checking and adjusting front and rear wheel caster, camber; and toe as required; center steering wheel.

4. Check toe-out-on-turns (turning radius); determine necessary action.

5. Check SAI (steering axis inclination) and included angle; determine necessary action.

6. Check rear wheel thrust angle; determine necessary action.

7. Check for front wheel setback; determine necessary action.

8. Check front and/or rear cradle (subframe) alignment; determine necessary action.

D. Wheel and Tire Diagnosis and Repair

1. Inspect tire condition; identify tire wear patterns; check and adjust air pressure; determine necessary action.

2. Diagnose wheel/tire vibration, shimmy, and noise; determine necessary action.

3. Rotate tires according to manufacturer’s recommendations.

4. Measure wheel, tire, axle flange, and hub runout; determine necessary action.

5. Diagnose tire pull problems; determine necessary action.

6. Dismount, inspect, and remount tire on wheel; Balance wheel and tire assembly (static and dynamic).

7. Dismount, inspect, and remount tire on wheel equipped with tire pressure monitoring system

sensor.

8. Reinstall wheel; torque lug nuts.

9. Inspect tire and wheel assembly for air loss; perform necessary action.

10. Repair tire using internal patch.

11. Inspect, diagnose, and calibrate tire pressure monitoring system.

BRAKES

Content Area	Questions In Test
A. Hydraulic System Diagnosis and Repair	9
B. Drum Brake Diagnosis and Repair	6
C. Disc Brake Diagnosis and Repair	9
D. Power Assist Units Diagnosis and Repair	3
E. Miscellaneous (Wheel Bearing, Parking Brakes, Electrical, Etc.)	4
F. Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair	9
TOTAL	40

A. Hydraulic System Diagnosis and Repair

1. Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law).

2. Measure brake pedal height, travel, and free play (as applicable); determine necessary action.

3. Check master cylinder for internal/external leaks and proper operation; determine necessary action.

4. Remove, bench bleed, and reinstall master cylinder.

5. Diagnose poor stopping, pulling or dragging concerns caused by malfunctions in the hydraulic system; determine necessary action.

6. Inspect brake lines, flexible hoses, and fittings for leaks, dents, kinks, rust, cracks, bulging or wear; tighten loose fittings and supports; determine necessary action.

7. Replace brake lines, hoses, fittings, and supports.

8. Fabricate brake lines using proper material and flaring procedures (double flare and ISO types).

9. Select, handle, store, and fill brake fluids to proper level.

10. Inspect, test, and/or replace metering (hold-off), proportioning (balance), pressure differential, and combination valves.

11. Inspect, test, and/or replace components of brake warning light system.

12. Bleed and/or flush brake system.

13. Test brake fluid for contamination.

B. Drum Brake Diagnosis and Repair

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine necessary action.

2. Remove, clean, inspect, and measure brake drums; determine necessary action.

3. Refinish brake drum; measure final drum diameter.

4. Remove, clean, and inspect brake shoes, springs, pins, clips, levers, adjusters/self-adjusters, other related brake hardware, and backing support plates; lubricate and reassemble.

5. Inspect and install wheel cylinders.

6. Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings.

7. Install wheel, torque lug nuts, and make final checks and adjustments.

C. Disc Brake Diagnosis and Repair

1. Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pulsation concerns; determine necessary action.

2. Remove caliper assembly; inspect for leaks and damage to caliper housing; determine necessary action.

3. Clean and inspect caliper mounting and slides/pins for operation, wear, and damage; determine necessary action.

4. Remove, inspect and replace pads and retaining hardware; determine necessary action.

5. Disassemble and clean caliper assembly; inspect parts for wear, rust, scoring, and damage; replace seal, boot, and damaged or worn parts.

6. Reassemble, lubricate, and reinstall caliper, pads, and related hardware; seat pads, and inspect for leaks.

7. Clean, inspect, and measure rotor thickness, lateral runout, and thickness variation; determine necessary action

8. Remove and reinstall rotor.

9. Refinish rotor on vehicle; measure final rotor thickness.

10. Refinish rotor off vehicle; measure final rotor thickness.

11. Retract caliper piston on an integrated parking brake system.

12. Install wheel, torque lug nuts, and make final checks and adjustments.

13. Check brake pad wear indicator system operation; determine necessary action.

D. Power Assist Units Diagnosis and Repair

1. Test pedal free travel; check power assist operation.

2. Check vacuum supply to vacuum-type power booster.

3. Inspect the vacuum-type power booster unit for leaks; inspect the check valve for proper operation; determine necessary action.

4. Inspect and test hydraulically assisted power brake system for leaks and proper operation; determine necessary action.

5. Measure and adjust master cylinder pushrod length.

E. Miscellaneous (Wheel Bearings, Parking Brakes, Electrical, Etc.) Diagnosis and Repair

1. Diagnose wheel bearing noises, wheel shimmy, and vibration concerns; determine necessary action.

2. Remove, clean, inspect, repack, and install wheel bearings and replace seals; install hub and adjust bearings.

3. Check parking brake cables and components for wear, binding, and corrosion; clean, lubricate, adjust or replace as needed.

4. Check parking brake and indicator light system operation; determine necessary action.

5. Check operation of brake stop light system; determine necessary action.

6. Replace wheel bearing and race.
7. Inspect and replace wheel studs.

8. Remove and reinstall sealed wheel bearing assembly.

F. Electronic Brake, Traction and Stability Control Systems Diagnosis and Repair

1. Identify and inspect electronic brake control system components; determine necessary action.

2. Diagnose poor stopping, wheel lock-up, abnormal pedal feel, unwanted application, and noise concerns associated with the electronic brake control system ; determine necessary action.

3. Diagnose electronic brake control system electronic control(s) and components by retrieving diagnostic trouble codes, and/or using recommended test equipment; determine necessary action.

4. Depressurize high-pressure components of the electronic brake control system.

5. Bleed the electronic brake control system hydraulic circuits.

6. Remove and install electronic brake control system electrical/electronic and hydraulic components.

7. Test, diagnose, and service electronic brake control system speed sensors (digital and analog), toothed ring (tone wheel), and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO) (includes output signal, resistance, shorts to voltage/ground, and frequency data).

8. Diagnose electronic brake control system braking concerns caused by vehicle modifications (tire size, curb height, final drive ratio, etc.).

9. Identify traction control/vehicle stability control system components.

10. Describe the operation of a regenerative braking system.

ELECTRICAL/ELECTRONIC SYSTEMS

Content Area	Questions In Test
A. General Electrical System Diagnosis	10
B. Battery Diagnosis and Repair	5
C. Starting System Diagnosis and Repair	5
D. Charging System Diagnosis and Repair	5
E. Lighting System Diagnosis and Repair	5
F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair	3
G. Horn and Wiper/Washer Diagnosis and Repair	3
H. Accessories Diagnosis and Repair	4
TOTAL	40

A. General Electrical System Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

2. Identify and interpret electrical/electronic system concern; determine necessary action.

3. Research applicable vehicle and service information, such as electrical/electronic system operation, vehicle service history, service precautions, and technical service bulletins.

4. Locate and interpret vehicle and major component identification numbers.

5. Diagnose electrical/electronic integrity of series, parallel and series-parallel circuits using principles of electricity (Ohm's Law).

6. Use wiring diagrams during diagnosis of electrical circuit problems.

7. Demonstrate the proper use of a digital multimeter (DMM) during diagnosis of electrical circuit problems, including: source voltage, voltage drop, current flow, and resistance.

8. Check electrical circuits with a test light; determine necessary action.

9. Check electrical/electronic circuit waveforms; interpret readings and determine needed repairs.

10. Check electrical circuits using fused jumper wires; determine necessary action.

11. Locate shorts, grounds, opens, and resistance problems in electrical/electronic circuits; determine necessary action.

12. Measure and diagnose the cause(s) of excessive parasitic draw; determine necessary action.

13. Inspect and test fusible links, circuit breakers, and fuses; determine necessary action.

14. Inspect and test switches, connectors, relays, solenoid solid state devices, and wires of electrical/electronic circuits; perform necessary action.

15. Remove and replace terminal end from connector; replace connectors and terminal ends.

16. Repair wiring harness (including CAN/BUS systems).

17. Perform solder repair of electrical wiring.

18. Identify location of hybrid vehicle high voltage circuit disconnect (service plug) location and safety procedures

B. Battery Diagnosis and Service

1. Perform battery state-of-charge test; determine necessary action.
2. Perform battery capacity test; confirm proper battery capacity for vehicle application; determine necessary action.
3. Maintain or restore electronic memory functions.
4. Inspect, clean, fill, and/or replace battery, battery cables, connectors, clamps, and hold-downs.
5. Perform battery charge.
6. Start a vehicle using jumper cables or an auxiliary power supply.
7. Identify high voltage circuits of electric or hybrid electric vehicle and related safety precautions.
8. Identify electronic modules, security systems, radios, and other accessories that require reinitialization or code entry following battery disconnect.
9. Identify hybrid vehicle auxiliary (12v) battery service, repair and test procedures.

C. Starting System Diagnosis and Repair

1. Perform starter current draw tests; determine necessary action.
2. Perform starter circuit voltage drop tests; determine necessary action.
3. Inspect and test starter relays and solenoids; determine necessary action.
4. Remove and install starter in a vehicle.
5. Inspect and test switches, connectors, and wires of starter control circuits; perform necessary action.
6. Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition.

D. Charging System Diagnosis and Repair

1. Perform charging system output test; determine necessary action.
2. Diagnose charging system for the cause of undercharge, no-charge, and overcharge conditions.
3. Inspect, adjust, or replace generator (alternator) drive belts, pulleys, and tensioners; check pulley and belt alignment.
4. Remove, inspect, and install generator (alternator).
5. Perform charging circuit voltage drop tests; determine necessary action.

E. Lighting Systems Diagnosis and Repair

1. Diagnose the cause of brighter than normal, intermittent, dim, or no light operation; determine necessary action.
2. Inspect, replace, and aim headlights and bulbs.
3. Inspect and diagnose incorrect turn signal or hazard light operation; perform necessary action.
4. Identify system voltage and safety precautions associated with high intensity discharge headlights.

F. Gauges, Warning Devices, and Driver Information Systems Diagnosis and Repair

1. Inspect and test gauges and gauge sending units for cause of abnormal gauge readings; determine necessary action.
2. Inspect and test connectors, wires, and printed circuit boards of gauge circuits; determine necessary action.
3. Diagnose the cause of incorrect operation of warning devices and other driver information systems; determine necessary action.
4. Inspect and test sensors, connectors, and wires of electronic (digital) instrument circuits; determine necessary action.

G. Horn and Wiper/Washer Diagnosis and Repair

1. Diagnose incorrect horn operation; perform necessary action.
2. Diagnose incorrect wiper operation; diagnose wiper speed control and park problems; perform necessary action.
3. Diagnose incorrect washer operation; perform necessary action.

H. Accessories Diagnosis and Repair

1. Diagnose incorrect operation of motor-driven accessory circuits; determine necessary action.
2. Diagnose incorrect heated glass, mirror, or seat operation; determine necessary action.
3. Diagnose incorrect electric lock operation (including remote keyless entry); determine necessary action.
4. Diagnose incorrect operation of cruise control systems; determine necessary action.
5. Diagnose supplemental restraint system (SRS) concerns; determine necessary action.
6. Disarm and enable the airbag system for vehicle service.
7. Diagnose radio static and weak, intermittent, or no radio reception; determine necessary action.
8. Remove and reinstall door panel.
9. Diagnose body electronic system circuits using a scan tool; determine necessary action.

10. Check for module communication (including CAN/BUS systems) errors using a scan tool.

11. Diagnose the cause of false, intermittent, or no operation of anti-theft systems.

12. Describe the operation of keyless entry/remote-start systems.

13. Perform software transfers, software updates, or flash reprogramming on electronic modules.

ENGINE PERFORMANCE

Content Area	Questions In Test
A. General Engine Diagnosis	8
B. Computerized Engine Controls Diagnosis and Repair	10
C. Ignition System Diagnosis and Repair	6
D. Fuel, Air Induction, and Exhaust System Diagnosis and Repair	6
E. Emissions Control Systems Diagnosis and Repair	5
F. Engine Related Service	5
TOTAL	40

A. General Engine Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

2. Identify and interpret engine performance concern; determine necessary action.

3. Research applicable vehicle and service information, such as engine management system operation, vehicle service history, service precautions, and technical service bulletins.

4. Locate and interpret vehicle and major component identification numbers.

5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.

6. Diagnose abnormal engine noise or vibration concerns; determine necessary action.

7. Diagnose abnormal exhaust color, odor, and sound; determine necessary action.

8. Perform engine absolute (vacuum/boost) manifold pressure tests; determine necessary action.

9. Perform cylinder power balance test; determine necessary action.

10. Perform cylinder cranking and running compression tests; determine necessary action.

11. Perform cylinder leakage test; determine necessary action.

12. Diagnose engine mechanical, electrical, electronic, fuel, and ignition concerns; determine necessary action.

13. Prepare 4 or 5 gas analyzer; inspect and prepare vehicle for test, and obtain exhaust readings; interpret readings, and determine necessary action.

14. Verify engine operating temperature; determine necessary action.

15. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; perform necessary action.

16. Verify correct camshaft timing.

B. Computerized Engine Controls Diagnosis and Repair

1. Retrieve and record diagnostic trouble codes, OBD monitor status, and freeze frame data; clear codes when applicable.

2. Diagnose the causes of emissions or driveability concerns with stored or active diagnostic trouble codes; obtain, graph, and interpret scan tool data.

3. Diagnose emissions or driveability concerns without stored diagnostic trouble codes; determine necessary action.

4. Check for module communication (including CAN/BUS systems) errors using a scan tool.

5. Inspect and test computerized engine control system sensors, powertrain/engine control module (PCM/ECM), actuators, and circuits using a graphing multimeter (GMM)/digital storage oscilloscope (DSO); perform necessary action.

6. Access and use service information to perform step-by-step diagnosis.

7. Diagnose driveability and emissions problems resulting from malfunctions of interrelated systems (cruise control, security alarms, suspension controls, traction controls, A/C, automatic transmissions, non-OEM-installed accessories, or similar systems); determine necessary action.

8. Perform active tests of actuators using a scan tool; determine necessary action.

9. Describe the importance of running all OBDII monitors for repair verification.

C. Ignition System Diagnosis and Repair

1. Diagnose ignition system related problems such as no-starting, hard starting, engine misfire, poor driveability, spark knock, power loss, poor mileage, and emissions concerns; determine necessary action.

2. Inspect and test ignition primary and secondary circuit wiring and solid state components; test ignition coil(s); perform necessary action.

3. Inspect and test crankshaft and camshaft position sensor(s); perform necessary action.

4. Inspect, test, and/or replace ignition control module, powertrain/engine control module; reprogram as necessary.

D. Fuel, Air Induction, and Exhaust Systems Diagnosis and Repair

1. Diagnose hot or cold no-starting, hard starting, poor driveability, incorrect idle speed, poor idle, flooding, hesitation, surging, engine misfire, power loss, stalling, poor mileage, dieseling, and emissions problems; determine necessary action.

2. Check fuel for contaminants and quality; determine necessary action.

3. Inspect and test fuel pumps and pump control systems for pressure, regulation, and volume; perform necessary action.

4. Replace fuel filters.

5. Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmetered air.

6. Inspect and test fuel injectors.

7. Verify idle control operation.

8. Inspect the integrity of the exhaust manifold, exhaust pipes, muffler(s), catalytic converter(s), resonator(s), tail pipe(s), and heat shield(s); perform necessary action.

9. Perform exhaust system back-pressure test; determine necessary action.

10. Test the operation of turbocharger/supercharger systems; determine necessary action

E. Emissions Control Systems Diagnosis and Repair

1. Diagnose oil leaks, emissions, and driveability concerns caused by the positive crankcase ventilation (PCV) system; determine necessary action.

2. Inspect, test and service positive crankcase ventilation (PCV) filter/breather cap, valve, tubes, orifices, and hoses; perform necessary action.

3. Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; determine necessary action.

4. Inspect, test, service and replace components of the EGR system, including EGR tubing, exhaust passages, vacuum/pressure controls, filters and hoses; perform necessary action.

5. Inspect and test electrical/electronic sensors, controls, and wiring of exhaust gas recirculation (EGR) systems; perform necessary action.

6. Diagnose emissions and driveability concerns caused by the secondary air injection and catalytic converter systems; determine necessary action.

7. Inspect and test mechanical components of secondary air injection systems; perform necessary action.

8. Inspect and test electrical/electronically-operated components and circuits of air injection systems; perform necessary action.

9. Inspect and test catalytic converter efficiency.

10. Diagnose emissions and driveability concerns caused by the evaporative emissions control system; determine necessary action.

11. Inspect and test components and hoses of the evaporative emissions control system; perform necessary action.

12. Interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine necessary action.

F. Engine Related Service

1. Adjust valves on engines with mechanical or hydraulic lifters.

2. Remove and replace timing belt; verify correct camshaft timing.

3. Remove and replace thermostat and gasket/seal.

4. Inspect and test mechanical/electrical fans, fan clutch, fan shroud/ducting, air dams, and fan control devices; perform necessary action.

5. Perform common fastener and thread repairs, to include: remove broken bolt, restore internal and external threads, and repair internal threads with a threaded insert.

6. Perform engine oil and filter change.

7. Identify hybrid vehicle internal combustion engine service precautions.

ENGINE REPAIR

Content Area	Questions In Test
A. General Engine Diagnosis; Removal and Reinstallation (R&R)	9
B. Cylinder Head and Valve Train Diagnosis and Repair	12
C. Engine Block Assembly Diagnosis and Repair	6
D. Lubrication and Cooling Systems Diagnosis and Repair	9
E. General Knowledge	4
TOTAL	40

A. General Engine Diagnosis; Removal and Reinstallation (R & R)

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

2. Identify and interpret engine concern; determine necessary action.

3. Research applicable vehicle and service information, such as internal engine operation, vehicle service history, service precautions, and technical service bulletins.

4. Locate and interpret vehicle and major component identification numbers.

5. Inspect engine assembly for fuel, oil, coolant, and other leaks; determine necessary action.

6. Diagnose engine noises and vibrations; determine necessary action.

7. Diagnose the cause of excessive oil consumption, coolant consumption, unusual engine exhaust color and odor; determine necessary action.

8. Perform engine vacuum tests; determine necessary action.

9. Perform cylinder power balance tests; determine necessary action.

10. Perform cylinder cranking and running compression tests; determine necessary action.

11. Perform cylinder leakage tests; determine necessary action.

12. Remove and reinstall engine in an OBDII or newer vehicle; reconnect all attaching components and restore the vehicle to running condition.

13. Install engine covers using gaskets, seals and sealers as required.

14. Perform common fastener and thread repair, to include: remove broken bolt, restore internal and external threads, and repair internal threads with thread insert.

15. Inspect, remove and replace engine mounts.

B. Cylinder Head and Valve Train Diagnosis and Repair

1. Remove cylinder head; inspect gasket condition; install cylinder head and gasket; tighten according to manufacturer's specifications and procedures.

2. Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition.

3. Inspect valve springs for squareness and free height comparison; determine necessary action.

4. Replace valve stem seals on an assembled engine; inspect valve spring retainers, locks/keepers, and valve lock/keeper grooves; determine necessary action.

5. Inspect valve guides for wear; check valve stem-to-guide clearance; determine necessary action.

6. Inspect valves and valve seats; determine necessary action.

7. Check valve spring assembled height and valve stem height; determine necessary action.

8. Inspect pushrods, rocker arms, rocker arm pivots and shafts for wear, bending, cracks, looseness, and blocked oil passages (orifices); determine necessary action.

9. Inspect valve lifters; determine necessary action.

10. Adjust valves (mechanical or hydraulic lifters).

11. Inspect and replace camshaft and drive belt/chain (includes checking drive gear wear and backlash, end play, sprocket and chain wear, overhead cam drive sprocket(s), drive belt(s), belt tension, tensioners, camshaft reluctor ring/tone-wheel, and variable valve timing components).

12. Inspect and/or measure camshaft for runout, journal wear and lobe wear.

13. Inspect camshaft bearing surface for wear, damage, out-of-round, and alignment; determine necessary action.

14. Establish camshaft position sensor indexing.

C. Engine Block Assembly Diagnosis and Repair

1. Disassemble engine block; clean and prepare components for inspection and reassembly.

2. Inspect engine block for visible cracks, passage condition, core and gallery plug condition, and surface warpage; determine necessary action.

3. Inspect and measure cylinder walls/sleeves for damage, wear, and ridges; determine necessary action.

4. Deglaze and clean cylinder walls.

5. Inspect and measure camshaft bearings for wear, damage, out-of-round, and alignment; determine necessary action.

6. Inspect crankshaft for straightness, journal damage, keyway damage, thrust flange and sealing surface condition, and visual surface cracks; check oil passage condition; measure end play and journal wear; check crankshaft position sensor reluctor ring (where applicable); determine necessary action.

7. Inspect main and connecting rod bearings for damage and wear; determine necessary action.

8. Identify piston and bearing wear patterns that indicate connecting rod alignment and main

bearing bore problems; determine necessary action.

9. Inspect and measure piston skirts and ring lands; determine necessary action.

10. Remove and replace piston pin.

11. Determine piston-to-bore clearance.

12. Inspect, measure, and install piston rings.

13. Inspect auxiliary shaft(s) (balance, intermediate, idler, counterbalance or silencer); inspect shaft(s) and support bearings for damage and wear; determine necessary action; reinstall and time.

14. Remove, inspect or replace crankshaft vibration damper (harmonic balancer).

15. Assemble engine block.

D. Lubrication and Cooling Systems Diagnosis and Repair

1. Perform oil pressure tests; determine necessary action.

2. Inspect oil pump gears or rotors, housing, pressure relief devices, and pump drive; perform necessary action.

3. Perform cooling system pressure tests; check coolant condition; inspect and test radiator, pressure cap, coolant recovery tank, and hoses; determine necessary action.

4. Inspect, replace, and adjust drive belts, tensioners, and pulleys; check pulley and belt alignment.

5. Inspect and replace engine cooling and heater system hoses.

6. Inspect, test, and replace thermostat and gasket/seal.

7. Test coolant; drain and recover coolant; flush and refill cooling system with recommended coolant; bleed air as required.

8. Inspect, remove and replace water pump.

9. Remove and replace radiator.

10. Inspect, and test fans(s) (electrical or mechanical), fan clutch, fan shroud, and air dams.

11. Inspect auxiliary coolers; determine necessary action.

12. Inspect, test, and replace oil temperature and pressure switches and sensors.

13. Perform oil and filter change.

14. Identify causes of engine overheating.

HEATING AND AIR CONDITIONING

Content Area	Questions In Test
A. A/C System Diagnosis and Repair	8
B. Refrigeration System Component Diagnosis and Repair	8
C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair	4
D. Operating Systems and Related Controls Diagnosis and Repair	12
E. Refrigerant Recovery, Recycling, and Handling	4
F. General Knowledge	4
TOTAL	40

A. A/C System Diagnosis and Repair

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

2. Identify and interpret heating and air conditioning concern; determine necessary action.

3. Research applicable vehicle and service information, such as heating and air conditioning system operation, vehicle service history, service precautions, and technical service bulletins.

4. Locate and interpret vehicle and major component identification numbers.

5. Performance test A/C system; identify A/C system malfunctions.

6. Identify abnormal operating noises in the A/C system; determine necessary action.

7. Identify refrigerant type; select and connect proper gauge set; record temperature and pressure readings.

8. Leak test A/C system; determine necessary action.

9. Inspect the condition of refrigerant oil removed from the system; determine necessary action.

10. Determine recommended oil and oil capacity for system application.

11. Using scan tool, observe and record related HVAC data and trouble codes.

B. Refrigeration System Component Diagnosis and Repair

1. Diagnose A/C system conditions that cause the protection devices (pressure, thermal, and PCM) to interrupt system operation; determine necessary action.

2. Inspect and replace A/C compressor drive belts, pulleys, and tensioners; determine necessary action.

3. Inspect, test, and/or replace A/C compressor clutch components and/or assembly; check compressor clutch air gap and adjust as needed..

4. Remove, inspect, and reinstall A/C compressor and mountings; determine required oil quantity.

5. Identify hybrid vehicle A/C system electrical circuits, service and safety precautions.

6. Determine the need for an additional A/C system filter; perform necessary action.

7. Remove and inspect A/C system mufflers, hoses, lines, fittings, O-rings, seals, and service valves; perform necessary action.

8. Inspect A/C condenser for airflow restrictions; perform necessary action.

9. Remove, inspect, and reinstall receiver/drier or accumulator/drier; determine required oil quantity.

10. Remove, inspect, and install expansion valve or orifice (expansion) tube.

11. Inspect evaporator housing water drain; perform necessary action.

12. Remove, inspect, and reinstall evaporator; determine required oil quantity.

13. Remove, inspect, and reinstall condenser; determine required oil quantity.

C. Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair

1. Diagnose temperature control problems in the heater/ventilation system; determine necessary action.
2. Perform cooling system pressure tests; check coolant condition, inspect and test radiator, cap (pressure/vacuum), coolant recovery tank, and hoses; perform necessary action.

3. Inspect engine cooling and heater system hoses and belts; perform necessary action.

4. Inspect, test, and replace thermostat and gasket/seal.

5. Determine coolant condition and coolant type for vehicle application; drain and recover coolant.

6. Flush system; refill system with recommended coolant; bleed system.

7. Inspect and test cooling fan, fan clutch, fan shroud, and air dams; perform necessary action.

8. Inspect and test electric cooling fan, fan control system and circuits; determine necessary action.

9. Inspect and test heater control valve(s); perform necessary action.

10. Remove, inspect, and reinstall heater core.

D. Operating Systems and Related Controls Diagnosis and Repair

1. Diagnose malfunctions in the electrical controls of heating, ventilation, and A/C (HVAC) systems; determine necessary action.

2. Inspect and test A/C-heater blower, motors, resistors, switches, relays, wiring, and protection devices; perform necessary action.

3. Test and diagnose A/C compressor clutch control systems; determine necessary action.

4. Diagnose malfunctions in the vacuum, mechanical, and electrical components and controls of the heating, ventilation, and A/C (HVAC) system; determine necessary action.

5. Inspect and test A/C-heater control panel assembly; determine necessary action.

6. Inspect and test A/C-heater control cables, motors, and linkages; perform necessary action.

7. Inspect A/C-heater ducts, doors, hoses, cabin filters and outlets; perform necessary action.

8. Identify the source of A/C system odors.

9. Check operation of automatic or semi-automatic heating, ventilation, and air-conditioning (HVAC) control systems; determine necessary action.

E. Refrigerant Recovery, Recycling, and Handling

1. Perform correct use and maintenance of refrigerant handling equipment according to equipment manufacturer's standards.

2. Identify and recover A/C system refrigerant.

3. Recycle, label, and store refrigerant.

4. Evacuate and charge A/C system; add refrigerant oil as required.

AUTOMATIC TRANSMISSION AND TRANSAXLE

Content Area	Questions In Test
A. General Transmission and Transaxle Diagnosis	18
B. In-Vehicle Transmission and Transaxle Repair	10
C. Off-Vehicle Transmission and Transaxle Repair	8
D. General Knowledge	4
TOTAL	40

A. General Transmission and Transaxle Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

2. Identify and interpret transmission/transaxle concern; differentiate between engine performance and transmission/transaxle concerns; determine necessary action.

3. Research applicable vehicle and service information, such as transmission/transaxle system operation, fluid type, vehicle service history, service precautions, and technical service bulletins.

4. Locate and interpret vehicle and major component identification numbers.

5. Diagnose fluid loss and condition concerns; check fluid level in transmissions with and without dip-stick; determine necessary action.

6. Perform pressure tests (including transmissions/transaxles equipped with electronic pressure control); determine necessary action.

7. Perform stall test; determine necessary action.

8. Perform lock-up converter system tests; determine necessary action.

9. Diagnose noise and vibration concerns; determine necessary action.

10. Diagnose transmission/transaxle gear reduction/multiplication concerns using driving, driven, and held member (power flow) principles.

12. Diagnose pressure concerns in a transmission using hydraulic principles (Pascal's Law).

13. Diagnose electronic transmission/transaxle control systems using appropriate test equipment and service information.

B. In-Vehicle Transmission/Transaxle Maintenance and Repair

1. Inspect, adjust, and replace manual valve shift linkage, transmission range sensor/switch, and park/neutral position switch.

2. Inspect and replace external seals gaskets, and bushings.

3. Inspect, test, adjust, repair, or replace electrical/electronic components and circuits, including computers, solenoids, sensors, relays, terminals, connectors, switches, and harnesses.

4. Diagnose electronic transmission control systems using a scan tool; determine necessary action.

5. Inspect, replace, and align powertrain mounts.

6. Service transmission; perform visual inspection; replace fluid and filters.

C. Off-Vehicle Transmission and Transaxle Repair

1. Remove and reinstall transmission/transaxle and torque converter; inspect engine core plugs, rear crankshaft seal, dowel pins, dowel pin holes, and mating surfaces.

2. Disassemble, clean, and inspect transmission/transaxle.

3. Inspect, measure, clean, and replace valve body (includes surfaces, bores, springs, valves, sleeves, retainers, brackets, checkvalves/balls, screens, spacers, and gaskets).

4. Inspect servo and accumulator bores, pistons, seals, pins, springs, and retainers; determine necessary action.

5. Assemble transmission/transaxle.

6. Inspect, leak test, and flush or replace transmission/transaxle oil cooler, lines, and fittings.

7. Inspect converter flex (drive) plate, converter attaching bolts, converter pilot, converter pump drive surfaces, converter end play, and crankshaft pilot bore.

8. Install and seat torque converter to engage drive/splines.

9. Inspect, measure, and reseal oil pump assembly and components.

10. Measure transmission/transaxle end play or preload; determine necessary action.

11. Inspect, measure, and replace thrust washers and bearings.

12. Inspect oil delivery circuits, including seal rings, ring grooves, and sealing surface areas, feed pipes, orifices, and check valves/balls.

13. Inspect bushings; determine necessary action.

14. Inspect and measure planetary gear assembly components; determine necessary action.

15. Inspect case bores, passages, bushings, vents, and mating surfaces; determine necessary action.

16. Inspect transaxle drive, link chains, sprockets, gears, bearings, and bushings; perform necessary action.

17. Inspect, measure, repair, adjust or replace transaxle final drive components.

18. Inspect clutch drum, piston, check-balls, springs, retainers, seals, and friction and pressure plates; determine necessary action.

19. Measure clutch pack clearance; determine necessary action.

20. Air test operation of clutch and servo assemblies.

21. Inspect roller and sprag clutch, races, rollers, sprags, springs, cages, and retainers;

determine necessary action.

22. Inspect bands and drums; determine necessary action.

23. Describe the operational characteristics of a continuously variable transmission (CVT)

24. Describe the operational characteristics of a hybrid vehicle drive train.

MANUAL DRIVE TRAIN AND AXLES

Content Area	Questions In Test
A. General Drive Train Diagnosis	5
B. Clutch Diagnosis and Repair	5
C. Transmission/Transaxle Diagnosis and Repair	7
D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair	5
E. Drive Axle Diagnosis and Repair	6
F. Four-Wheel Drive/All-Wheel Drive Component Diagnosis And Repair	7
G. General	5
TOTAL	40

A. General Drive Train Diagnosis

1. Complete work order to include customer information, vehicle identifying information, customer concern, related service history, cause, and correction.

2. Identify and interpret drive train concern; determine necessary action.

3. Research applicable vehicle and service information, such as drive train system operation, fluid type, vehicle service history, service precautions, and technical service bulletins.

4. Locate and interpret vehicle and major component identification numbers.

5. Diagnose fluid loss, level, and condition concerns; determine necessary action.
6. Drain and fill manual transmission/transaxle and final drive unit.

B. Clutch Diagnosis and Repair

1. Diagnose clutch noise, binding, slippage, pulsation, and chatter; determine necessary action.

2. Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots, and springs; perform necessary action.

3. Inspect hydraulic clutch slave and master cylinders, lines, and hoses; determine necessary action.

4. Inspect and replace clutch pressure plate assembly, clutch disc, release (throw-out) bearing and linkage, and pilot bearing/bushing (as applicable).

5. Bleed clutch hydraulic system.

6. Inspect flywheel and ring gear for wear and cracks; determine necessary action.

7. Inspect engine block, core plugs, rear main engine oil seal, clutch (bell) housing, transmission/transaxle case mating surfaces, and alignment dowels; determine necessary action.

8. Measure flywheel runout and crankshaft end play; determine necessary action.

C. Transmission/Transaxle Diagnosis and Repair

1. Remove and reinstall transmission/transaxle.

2. Disassemble, clean, and reassemble transmission/transaxle components.

3. Inspect transmission/transaxle case, extension housing, case mating surfaces, bores, bushings, and vents; perform necessary action.

4. Diagnose noise concerns using transmission/transaxle powerflow principles.

5. Diagnose hard shifting and jumping out of gear concerns; determine necessary action.

6. Inspect, adjust, and reinstall shift linkages, brackets, bushings, cables, pivots, and levers.

7. Inspect, replace, and align powertrain mounts.

8. Inspect and replace gaskets, seals, and sealants; inspect sealing surfaces.

9. Remove and replace transaxle final drive.

10. Inspect, adjust, and reinstall shift cover, forks, levers, grommets, shafts, sleeves, detent mechanism, interlocks, and springs.

11. Measure end play or preload (shim or spacer selection procedure) on transmission/transaxle shafts; perform necessary action.

12. Inspect and reinstall synchronizer hub, sleeve, keys (inserts), springs, and blocking rings.

13. Diagnose transaxle final drive assembly noise and vibration concerns; determine necessary action.

14. Remove, inspect, measure, adjust, and reinstall transaxle final drive pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case assembly.

15. Inspect lubrication devices (oil pump or slingers); perform necessary action.

16. Inspect, test, and replace transmission/transaxle sensors and switches.

17. Describe the operational characteristics of an electronically controlled manual transmission/transaxle.

D. Drive Shaft and Half Shaft, Universal and Constant-Velocity (CV) Joint Diagnosis and Repair

1. Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action.

2. Diagnose universal joint noise and vibration concerns; perform necessary action.

3. Remove and replace front wheel drive (FWD) front wheel bearing.
4. Inspect, service, and replace shafts, yokes, boots, and CV joints.

5. Inspect, service, and replace shaft center support bearings.

6. Check shaft balance and phasing; measure shaft runout; measure and adjust driveline angles.

E. Drive Axle Diagnosis and Repair

1. Ring and Pinion Gears and Differential Case Assembly

1. Diagnose noise and vibration concerns; determine necessary action.
2. Diagnose fluid leakage concerns; determine necessary action.
3. Inspect and replace companion flange and pinion seal; measure companion flange runout.
4. Inspect ring gear and measure runout; determine necessary action.
5. Remove, inspect, and reinstall drive pinion and ring gear, spacers, sleeves, and bearings.
6. Measure and adjust drive pinion depth.
7. Measure and adjust drive pinion bearing preload.
8. Measure and adjust side bearing preload and ring and pinion gear total backlash and backlash variation on a differential carrier assembly (threaded cup or shim types).
9. Check ring and pinion tooth contact patterns; perform necessary action.
10. Disassemble, inspect, measure, and adjust or replace differential pinion gears (spiders), shaft, side gears, side bearings, thrust washers, and case.
11. Reassemble and reinstall differential case assembly; measure runout; determine necessary action.

2. Limited Slip Differential

1. Diagnose noise, slippage, and chatter concerns; determine necessary action.
2. Clean and inspect differential housing; refill with correct lubricant and/or additive.
3. Inspect and reinstall limited slip differential components.
4. Measure rotating torque; determine necessary action.

3. Drive Axle Shaft

1. Diagnose drive axle shafts, bearings, and seals for noise, vibration, and fluid leakage concerns; determine necessary action.
2. Inspect and replace drive axle shaft wheel studs.
3. Remove and replace drive axle shafts.
4. Inspect and replace drive axle shaft seals, bearings, and retainers.
5. Measure drive axle flange runout and shaft end play; determine necessary action.

F. Four-wheel Drive/All-wheel Drive Component Diagnosis and Repair

1. Diagnose noise, vibration, and unusual steering concerns; determine necessary action.

2. Inspect, adjust, and repair shifting controls (mechanical, electrical, and vacuum), bushings, mounts, levers, and brackets.

3. Remove and reinstall transfer case.

4. Disassemble, service, and reassemble transfer case and components.

5. Inspect front-wheel bearings and locking hubs; perform necessary action.

6. Check drive assembly seals and vents; check lube level.

7. Diagnose, test, adjust, and replace electrical/electronic components of four-wheel drive systems.

8. Identify concerns related to variations in tire circumference and/or final drive ratios.